Best Practices for Managing Aerial and UAS Frame Imagery

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Objectives

- Manage and share collections of imagery from aerial frame cameras
  - Professional digital cameras
    - Metric lens, precise positioning with GPS & IMU
  - Uncalibrated frame cameras on unmanned aerial systems (UAS) or drones
Imaging modes and data: UAV data collection

• **Single image frames**
  - Geotagged, or may include full orientation metadata
  - May be nadir or oblique (low / high)

• **Aerial video**
  - Typically geotagged (GPS only)
  - May have MISB (orientation) metadata

• **Lidar**
  - Rare today from UAV, but coming…

• **Other sensors & modes possible**
  - Atmospheric, chemical, *in situ* sample & return, etc.
Data Products from UAV data collection

- Accurate orthophotos
  - Resolution typically in cm
- Oriented oblique photos
  - Multiple view angles
- 3D point clouds
- 3D models
- Geotagged video
- Bare earth DEM, first return DSM

Close range imagery (inspection)
Oblique imagery
Nadir imagery
Full Motion Video
Lidar
Image Management Workflow Using Mosaic Datasets
Highly Scalable, From Small to Massive Volumes of Imagery

Create Catalog of Imagery
- Reference Sources
- Ingest & Define Metadata
- Define Processing to be Applied

Apply:
- On-the-fly Processing
- Dynamic Mosaicking

Access as Image or Catalog
Support for Aerial and UAV/UAS Imagery data

- Use Mosaic Dataset to manage both film and digital frame camera data
- A generic solution to support thousands of different cameras
- Required information*:
  - Interior camera parameters
  - Exterior frame parameters

* If this metadata is not available, a solution for simple geotagged (GPS) imagery is also available.
Basic workflow in ArcGIS

- Create Mosaic Dataset
- Use Raster Type to ingest data from different sensors
  - Applanix
  - Match-AT
  - Frame Camera *(new at 10.3.1)*
- Populate integrated metadata into Mosaic Dataset
  - Sensor Azimuth/Elevation
  - Other metadata may be added to facilitate management & analysis
- Share as image service
Prepare inputs for Frame Camera Raster Type

- Consolidate exterior/Interior orientation parameters
  - GPS file
  - Camera file
  - Frame parameters file (*.txt, *.csv, or *.xml)

- Create Frames and/or Cameras table
  - Format the orientation parameters to Frame Camera Raster Type schema
  - Supports radial distortion correction
  - Works for any camera
  - Input format can be csv/txt/feature class/GDB table

See in ArcGIS Help System:
http://esriurl.com/FrameSchema
http://esriurl.com/CameraSchema

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Two approaches

• Images with complete orientation parameters
  - LeadAir
  - UltraCam
  - etc.

  ➔ Generate Frames and/or Cameras table from calibration report, etc.

• Orientation parameters generated by partner software
  - Icaros OneButton™
  - Pix4d Mapper™
  - etc.

  ➔ Generate Frames and/or Cameras table from exported project report.

*Best Practices for Managing Aerial and UAS Frame Imagery*
Demo

Mosaic dataset workflow
Geotagged images

- Create ArcGIS Online story map
Best Practices for Managing Aerial and UAS Frame Imagery

- Required: PerspectiveX/Y/Z and image path (relative or absolute)
- Omega/Phi/Kappa
- Add raster info fields to speed up ingest process
  - NCols, NRows, NBands, PixelType, SRS

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Frame Camera Raster Type – Frames table
Frame Camera Raster Type – Cameras table

- Focal length (microns)
- Principal point (microns)
- Image to camera affine transformation
- AverageZ or DSM
- Radial/Konrady correction

\[
x' = x \cdot (K_0 + K_1 \cdot r^2 + K_2 \cdot r^4 + K_3 \cdot r^6 + K_4 \cdot r^8)
\]
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where PS is camera’s film pixel size in microns.

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Summary – and links to further information

Best Practice Workflows for Image Management

Our focus was on creating the mosaic dataset for a single data collection using the Frame Camera Raster Type...

For more info re: data management & automation:

- Resource Center landing page  http://esriurl.com/6005
- Guidebook in Help System  http://esriurl.com/6007
- ArcGIS Online Group  http://esriurl.com/6539
- Downloadable scripts & sample data
- Recorded webinar:  http://esriurl.com/LTSImgMgmt
- Source code on GitHub